

# **Regional Screening, Selection and Geological Characterisation of the Saline Aquifer Structure "Schweinrich", a possible CO<sub>2</sub>-Storage Site for a large, lignite fired Power Plant in East Germany**

R. Meyer, F. May, C. Müller and C. Bernstone

Bundesanstalt für Geowissenschaften und Rohstoffe BGR (Germany) and Vattenfall (Sweden)

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- Site Screening / Investigation Area
- Germanys CO<sub>2</sub> storage potential
- Site Selection (+ ranking)
- Site Characterisation
- Lessons Learned and Open Questions

# Introduction

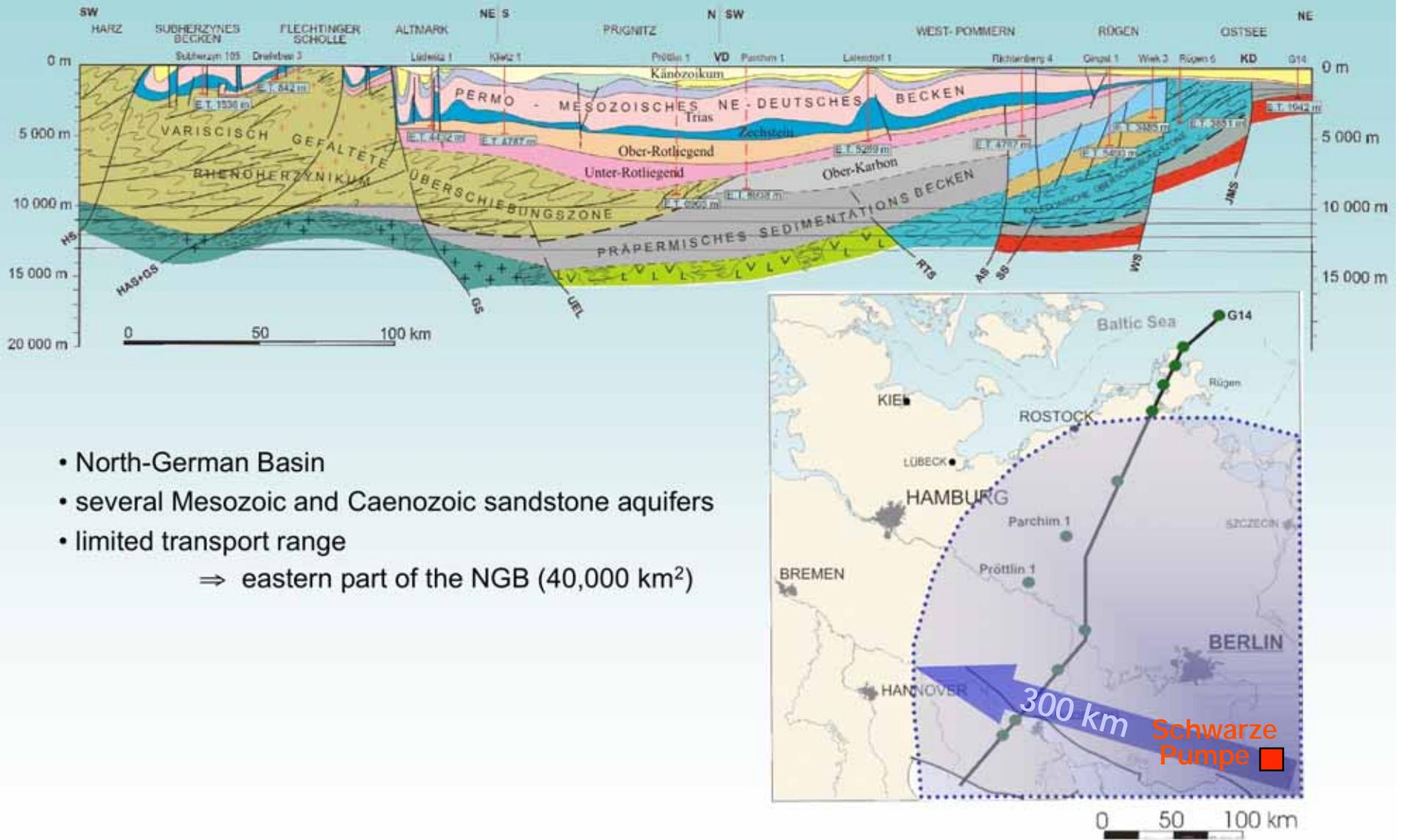
- **Main objective:** To investigate opportunities to store CO<sub>2</sub> captured from a 1,600 MW lignite power plant (service life time of 40 years, 400 Mt CO<sub>2</sub>)  
(>> Sleipner, Weyburn or In-Salah)
- R&D work of CO2STORE (co-founded by the European Commission, 5th framework)  
4 case studies in Europe + Sleipner <http://www.co2store.org/>
- Single storage site (structural closure + saline aquifer)
- Investigation area = NE-Germany
- Regional site screening
- Ranking and site selection
- Site characterisation (BGR, TNO, BRGM and Vattenfall)

## Pre-feasibility study

- relying on existing data only
- Which issues need to be addressed ?
- How far we can get before a commercial site exploration ?



# Site Screening - Investigation Area



- North-German Basin
- several Mesozoic and Caenozoic sandstone aquifers
- limited transport range

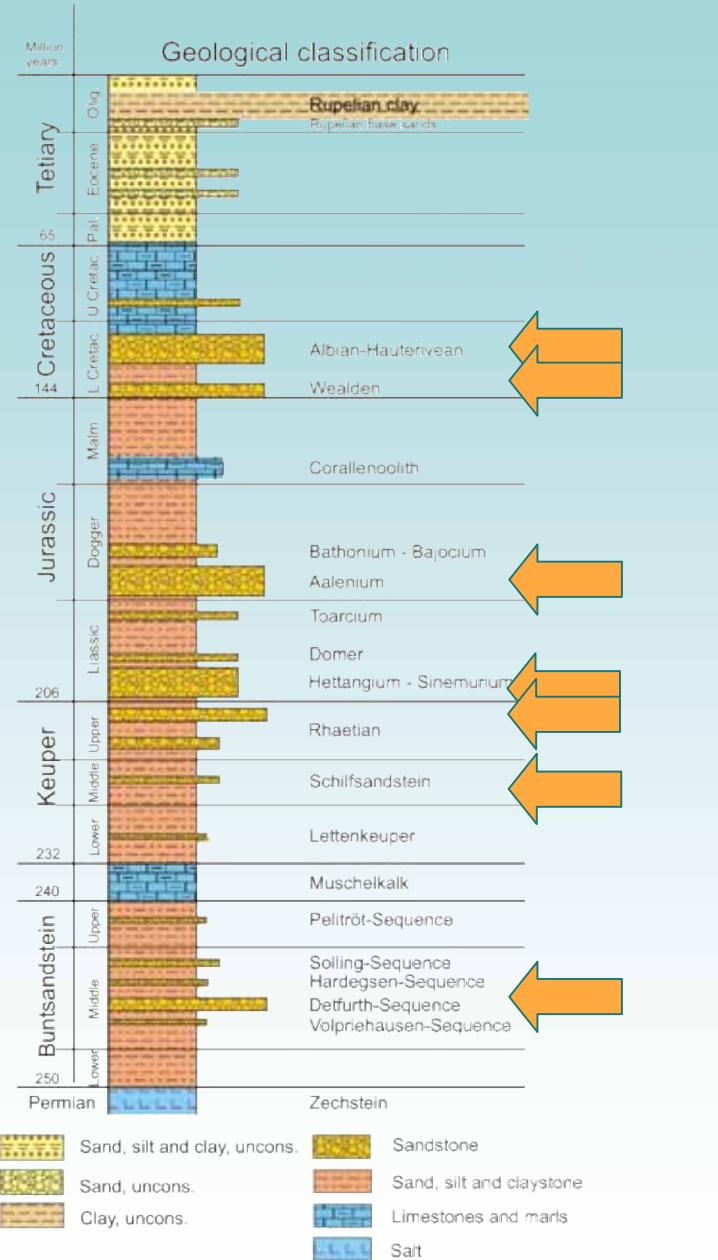
⇒ eastern part of the NGB (40,000 km<sup>2</sup>)



# Germanys potential for CO<sub>2</sub> storage...

## GESTCO project (2001-2003)

- CCS is a viable method of reducing greenhouse gas emissions ?
- capable of widespread application in Europe ?
- Evaluation of Germanys CO<sub>2</sub> storage potential:
  - ~ 20 to 30 ± 8 Gt CO<sub>2</sub> in saline aquifers
  - ~ 2.5 Gt CO<sub>2</sub> in gas fields (EGR)
  - 0.1 Gt CO<sub>2</sub> in oil fields
  - (coal seams)
- ⇒ considerable storage potential !
- geological heterogeneity ⇒ uncertainties



# Site Screening

## Procedure:

- Mapping the regional occurrence and relevant properties of saline aquifer formations using a geographical information system (GIS)

## Threshold values / criteria

- open aquifer & closed structures (anticlines)
  - depth: 900 to 4000 m
  - thickness of reservoir > 20 m
  - porosity > 20%
  - presence of reserve aquifer
  - suitable cap rock
  - data availability (pre-exploration)



# Pre-Evaluation and Ranking

## Results:

- 26 structures identified as potentially suitable for aquifer storage of CO<sub>2</sub>
- cumulative storage capacity ~ 7.5 Gt CO<sub>2</sub>

## Critical exclusion criteria:

- Storage capacity > 400 Mt CO<sub>2</sub>
- tectonically disturbed closed structure
- transport distance > 300 km
- conflicts with existing use

$$\Omega = A \times D \times \phi \times h_{st} \times \rho_{CO_2}$$

$\Omega$  = storage capacity [kg]

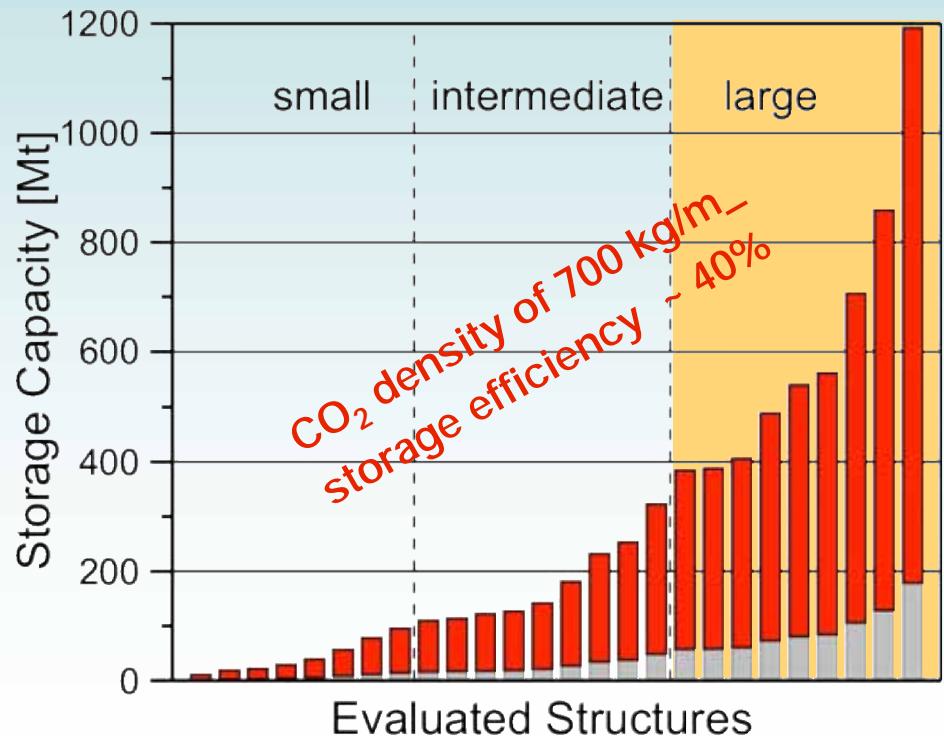
A = aerial distribution of the aquifer [m<sup>2</sup>]

D = cumulative thickness of good reservoir sandstones [m],

$\phi$  = effective porosity [%],

$h_{st}$  = storage efficiency [%],

$\rho_{CO_2}$  = density of carbon dioxide at reservoir conditions [kg/m<sup>3</sup>].

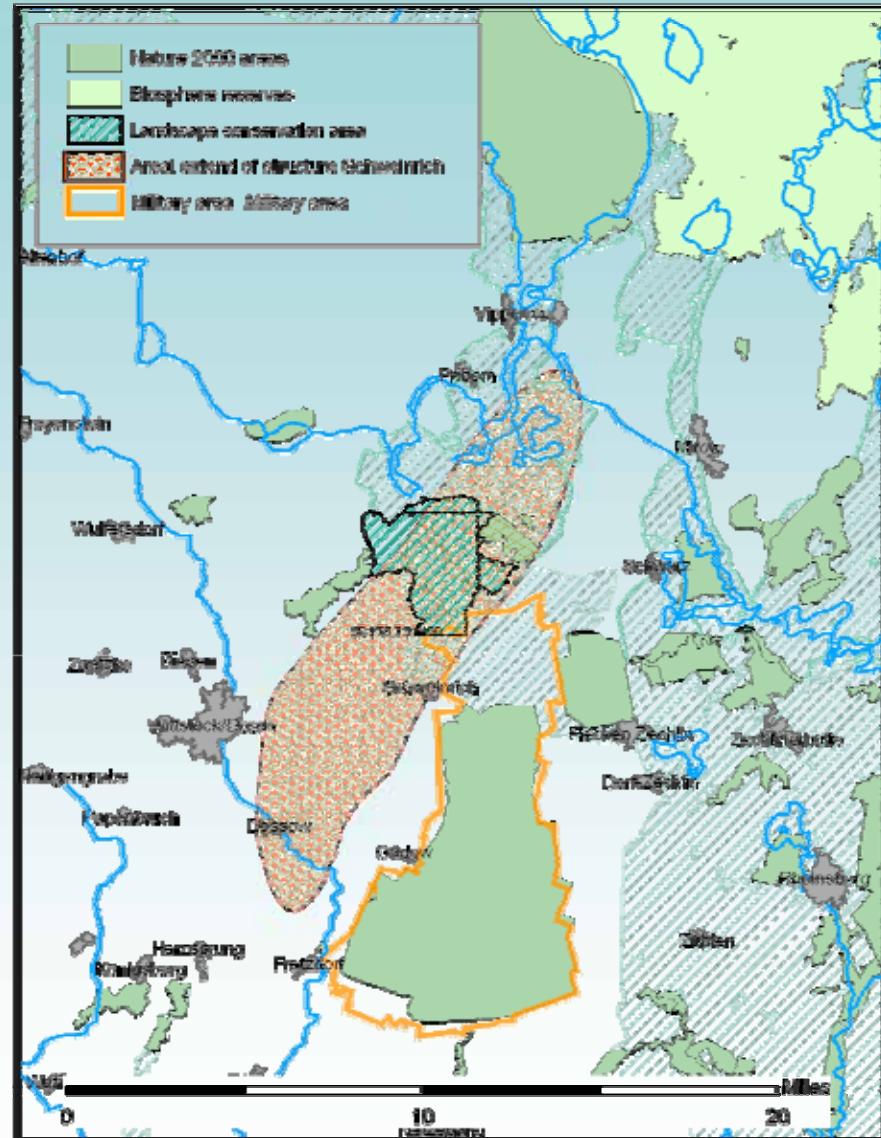


# Final Site Selection

9 remaining candidate sites ...

- Conflict of use
- Data availability (pre feasibility phase)
- Population density
- Several Nature areas
- Military areas
- Land use

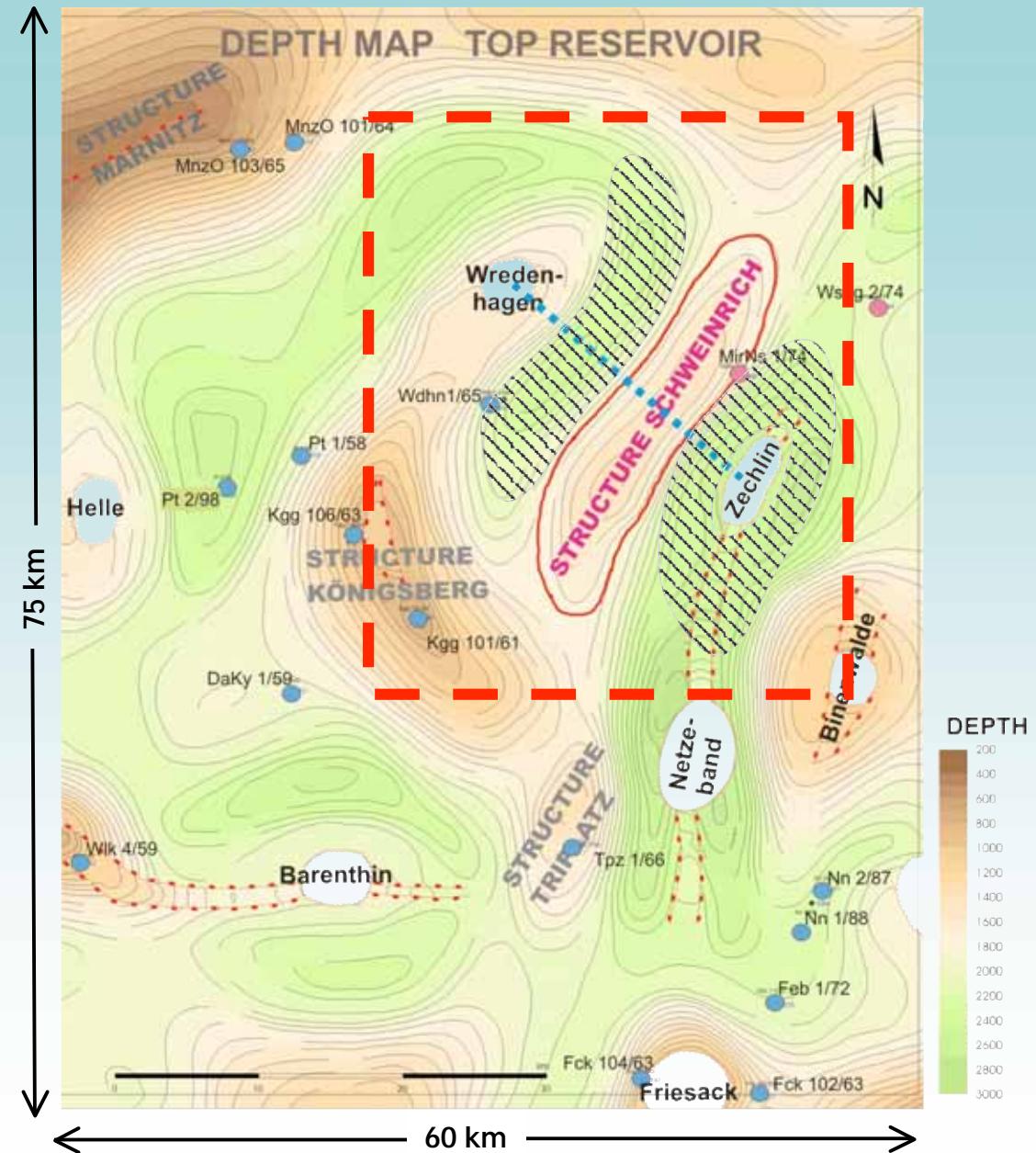
⇒ Structure Schweinrich is the most suitable candidate site



# Site Characterisation

available data: 2D seismic and wells

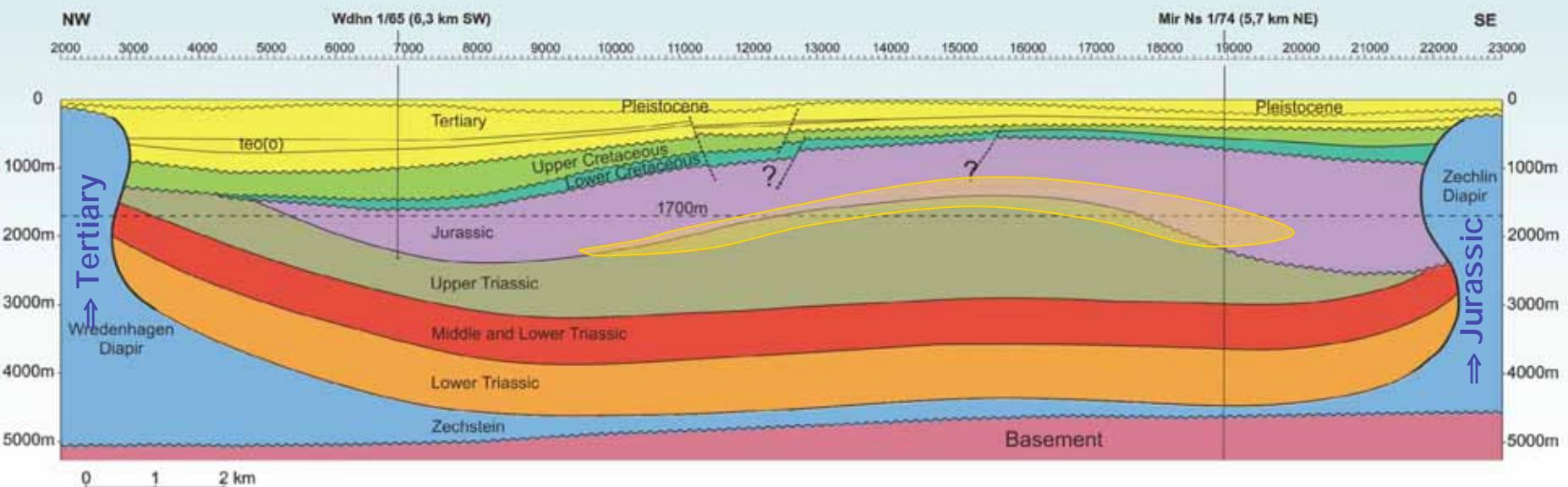
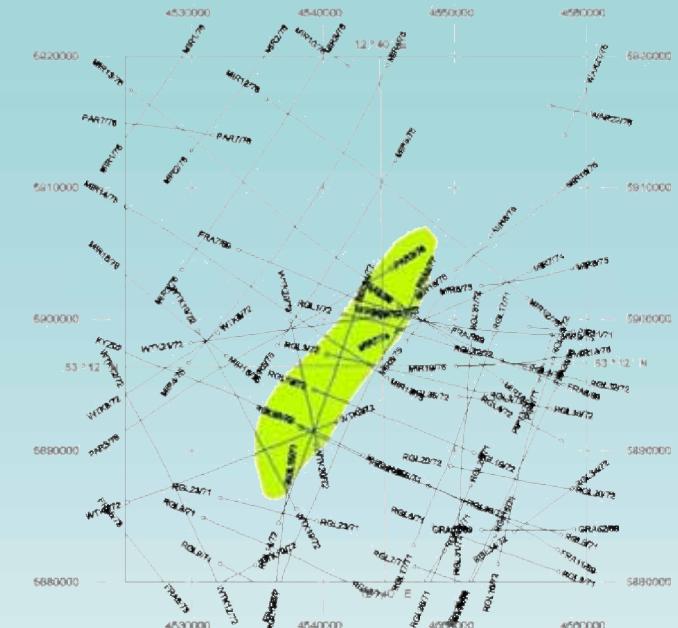
- tectonic/structural framework
- mapping the depth and thickness of reservoir
- petrophysical properties
- well core analysis (mineralogy, geochemistry)
- Risk Assessment  $\Rightarrow$  data gaps  
 $\Rightarrow$  new issues/ R&D
- 3D geological modelling (TNO + BGR)  
 $\Rightarrow$  available pore volume/storage potential  
 $\Rightarrow$  reservoir simulations (TNO)



# Site Characterisation

## Structure Schweinrich

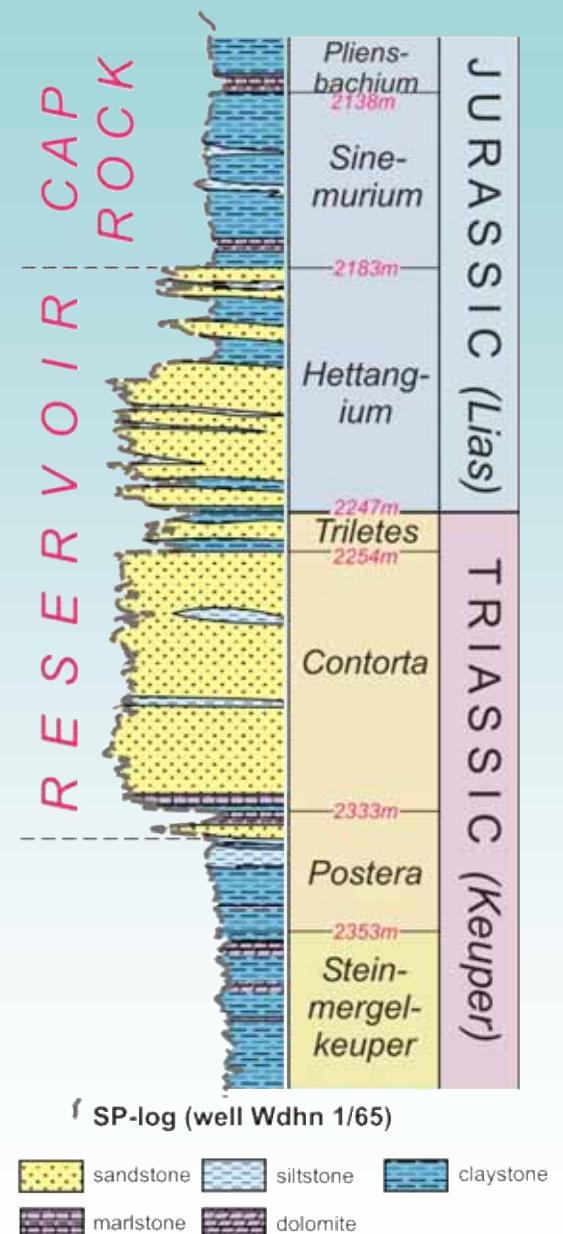
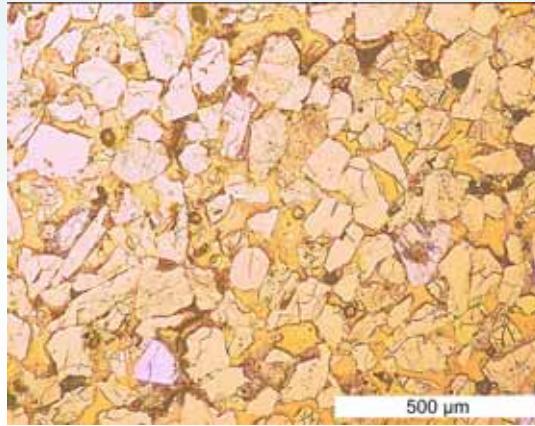
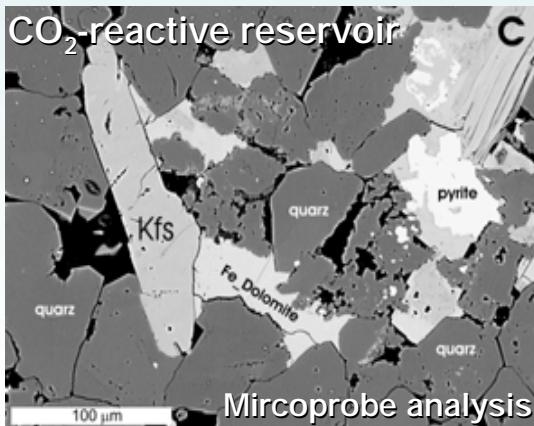
- passive anticlinal structure (turtle structure)
- aquifer stores below 1,300 m
- thickness 270 – 380 m
- sealed by a thick clay sequence
- faults in the overburden ... ?



# Geochemical / Mineralogical Characterisation

- sampling
- Mineralogical composition (XRD)
- Chemical composition (AAS)
  - CO<sub>2</sub>-reactive minerals
  - Carbonates in the cap rock (!)
- porosity ⇒ calibrating well log interpretation

- geochemical sensitivity (numerical modeling by BRGM)
- potential for CO<sub>2</sub>-dissolution
  - potential for CO<sub>2</sub>-precipitation in mineral form



# Lessons Learned and Open Questions...

## Site Screening and Selection

- systematic area-wide site screening using a geographic information system (GIS)
- we have identified several large potential storage sites in NE-Germany
- we have evaluated the storage potential in NE-Germany



## Site Characterisation

- successful characterization of one large candidate CO<sub>2</sub>-storage site  
(structural framework, reservoir properties, geochemical sensitivity and available pore volume)
- Structure Schweinrich seems to provide a sufficiently large storage potential (> 400 Mt CO<sub>2</sub>)
- pre-feasibility study revealed the gaps of data, e.g. geomechanical analysis, tectonic stress regimes, pressure capacity)



## We learned...

- the areal extend of a site characterisation is strongly controlled by...

- structural framework, average reservoir properties and
  - proposed CO<sub>2</sub> volumes ≈ pressure increase



- area affected by CO<sub>2</sub> storage might be very large... (tens of kilometers)



- at the moment, we can not prove the structural integrity of the storage system



- commercial site exploration is indispensable (new wells and 3D seismic) !



.... thank you very much !

Questions, please...